REMARKS

Claims 7-12, all the claims pending in the application, stand rejected. Claims 7-12 have been amended to clarify the subject matter that Applicant considers to be the invention.

Specification

The Examiner has objected to the Title as not descriptive. The Title has been amended to overcome the objection.

Claim Rejections – 35 USC 112

The Examiner has rejected claims 7-12 under 35 USC 112, first paragraph. This rejection is traversed for at least the following reasons.

The Examiner bases his rejection on the reference in the claims to CLE. The Examiner asserts that this subject matter was not disclosed in a manner that showed possession of the invention at the time the application was filed. Applicant disagrees, as one skilled in the art would have been able to derive and understand supportive teachings. However, in order to avoid discussion relating to the CLE, Applicant has redrafted the claims in a manner that contains no descriptions with regards to the CLE. Applicant believes that the claims are now clear and fully supported by the original disclosure.

Claim Rejections – 35 USC 102

Claims 7-12 are rejected under 35 USC 102 (e) as being anticipated by Hirayama et al (6,693,353). This rejection is traversed for at least the following reasons.

As a preliminary matter, Applicant notes that Hirayama et al and the present invention relate to a technology of obtaining a Cu-Mo compound heat dissipation substrate. However, there are significant differences, as recited in the amended claims, that patentably distinguish the reference from the invention.

First, Hirayama et al discloses technology which controls the coefficient of thermal expansion by only one direction rolling. By contrast, the present invention discloses a technology which controls the coefficient of thermal expansion by two-direction rolling. That is,

rolling is carried out in the present invention not only in a primary rolling direction but also in a secondary rolling direction, crossing direction to the primary rolling direction.

Second, the present invention also discloses a technology in which Cu is clad on both sides of the Cu-Mo compound material obtained by above-mentioned method. In Hirayama et al, there is clad on only one side.

The effect of these differences, particularly as reflected in amended claim 7, are significant, and clearly support patentability.

In Hirayama et al, when a Cu-Mo composite is rolled in the one rolling direction, Mo particles will be extended, such that they become long and slender in the rolling direction. The coefficient of thermal expansion in the rolling direction is controllable by expanding the Mo particles. However, in the one direction rolling of Hirayama et al, the coefficient of thermal expansion in the right-angled direction to the rolling direction is not controlled. Therefore, there arises an undesirable difference in the value of the coefficient of thermal expansion in the two directions. This problem, as a practical matter, is recognized and described in the specification of the present application.

In the present invention, particularly as defined in the method of claim 7, in order to collapse Mo particles in both directions and to equalize the coefficients of thermal expansion in both directions, that is, to acquire flat form, the rolling is carried out in two orthogonal directions, a first referred to a primary rolling direction and a second orthogonal direction referred in the present invention as a secondary rolling direction. In present invention, this significant feature results in a collapse the Mo particles into a flat shape. This means that the coefficient of thermal expansion is controlled in two orthogonal directions. Therefore, the present invention has a novel feature of being able to control the coefficient of thermal expansion and solve problem that existed with Hirayama et al and the conventional technology.

In order to assist the Examiner in understanding this feature, Applicant refers the Examiner to the following disclosure of the preferred Embodiment, particularly the following description, on page 14, lines 16 to 22 of the original specification.

"...a composite (45) after rolling has a structure in which the Mo particle (43) in the matrix of Cu (41) have a collapsed shape flattened in the rolling direction. As illustrated in Fig. 7, following the increase in secondary rolling rate, the Mo particles are gradually flattened in the order of reference numerals 51, 53, 55, and 57 and the coefficient of linear expansion is linearly decreased, as depicted by a straight line (59)."

With respect to the problems generated according to the difference of the coefficient of linear expansion of Hirayama et al in a practical application, it has pointed out as follows for this use of the background technology of the present invention.

(i) In the specification, page 4, lines 13 to 21, it is described that "AlN excellent in thermal conduction is generally used as an insulator substrate to be soldered to the heat dissipation substrate. During cooling after soldering the insulated board to the heat dissipation substrate, there arise problems, such as deformation of the heat dissipation substrate and fracture of the insulator substrate, as a result of the thermal strain. In order to prevent the occurrence of the above-mentioned problems, the material of the heart dissipation substrate is required to have a coefficient of thermal expansion of $9.0x10^{-6}$/K or less at a temperature not higher than 400°C. This is because ...."

(ii) In the specification, page 4, line 28 to page 5, line 15, it is described that "In such ceramic package also, a heat dissipation substrate having following characteristics in addition to excellent heat conduction is required in order to release heat produced by the semiconductor device to the out side of the package. As ceramics for a ceramic package, use id generally made of a material containing Al_2O_3 as a main component. For the heat dissipation substrate, it is requires to use a material such that, in case where the substrate is bonded to the ceramic by a high-temperature (about 800 °C) brazing material (CuAg eutectic brazing material or the like), the ceramics is not broken and the heat dissipation substrate is less deformed during cooling after brazing due to the thermal strain resulting from the difference in coefficient of thermal expansion from ceramic.

The present invention solves the above-problems (i) and (ii) in the Example 1 of the specification.

Therefore, the present invention has the following advantages over the prior art with respect to the resulting product.

(a) The heat dissipation board does not have a difference in the value of the heat rate of expansion of the primary rolling direction and the secondary rolling direction.

(b) The heat dissipation board has the heat rate of expansion in consideration of the junction temperature at the time of practical use. Namely, by carrying out crossing rolling as claimed, the coefficient of thermal expansion is controllable with sufficient accuracy and the anisotropy of thermal expansion can be lost so that deformation of the heat dissipation substrate and the crack of the insulator substrate and brazing material can be prevented because a thermal expansion coefficient is given according to soldering temperature and a brazing temperature.

As above-mentioned, Hirayama et al neither suggests nor teaches the above-mentioned the technical idea or means which the present invention described as the description in the specification. Therefore, Hirayama et al is different from the present invention. In addition, it is clear that the present invention has merits which are excellent with regard to the above-mentioned points (a) and (b) compared with the Hirayama et al, and the present invention is patentable thereover.

(3) The invention of Claim 9 , "a method of producing a clad material":

The object of this invention is a passage given in "Background Art" of the specification, Page 5, lines 12 to 21. That is, it is described that "In particular, in the event that the semiconductor device, such as GaAs, which produces high-temperature heat during operation and which is poor in thermal conduction is used, it is strongly desired to use a material excellent in thermal conduction at its surface to be contacted with the device. For this purpose, the Cu-W composite material generally used and the Mo-Cu composite material according to the prior art 1 may be insufficient in thermal conduction. At present, use is sometimes made of a [Cu / Mo / Cu] clad material (hereinafter will be referred to as CMC) in order to satisfy the above-mentioned requirement. However, the CMC clad material is disadvantageous in the following respects."

CPC manufactured by the method according to this invention is excellent as follows as compared with CMC. Hereafter, a description of an embodiment of the present invention on Page 15, lines 1 to 14 is referred to.

(i) At first, a intermediate layer comprises the Mo-Cu composite and contains copper. Therefore, it is possible to lower the temperature upon hot rolling for adhesion of the composite to copper. This brings about energy saving and high adhesion force.

(ii) Because of little difference in deformability between the cladding material and the intermediate layer, deformation of the layers as a result of rolling is small and the quality is stable.

(iii) The thermal characteristics are superior to those of the CMC because not only heat diffusion is performed in a horizontal (XY) direction but also copper is present in a thickness (Z) direction.

(iv) As regards the coefficient of thermal expansion, there is no problem because, by controlling the working rate of the Mo-Cu composite material as the intermediate layer without changing the thickness of the Cu layers, the coefficient of thermal expansion of 8.3×10^{-6}/K or less, which allows matching with the ceramic, is obtained. Furthermore, platability of Ni is more excellent because less exposure of Mo.

As compared with CMC of the conventional technology, based on the foregoing explanation of the present invention, the substrate, CPC, using the Cu-Mo composite material which is clad by Cu on both sides and the manufacture method of the same have inventive steps.

Applicant thus submits that the objections and rejections are overcome by the above amendment and argument, and that the present claims 7-12 should be allowable.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

Ronald Kimble Reg# 44,186
for

SUGHRUE MION, PLLC
Telephone: (202) 293-7060
Facsimile: (202) 293-7860

WASHINGTON OFFICE
23373
CUSTOMER NUMBER

Alan J. Kasper
Registration No. 25,426

Date: December 15, 2004